

Report No. UT-08.09

TECHCRETE® CONCRETE BRIDGE DECK PATCHING ON I-215

Experimental Feature X(04)02

FINAL REPORT

Prepared For:

Utah Department of Transportation
Research Division

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- Crew of Maintenance Station #230 (Tyson Vorwaller, present Supervisor)
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16. Abstract This study was proposed to further explore TechCrete's® viability as a bridge deck patching solution. The objectives of the test were to evaluate the speed and ease of product installation and to observe the durability of the product over four years.					
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EXECUTIVE SUMMARY

In response to the success of the TechCrete® concrete patching product on I-15 concrete pavement, this study was proposed to further explore TechCrete's® viability as a long-term patching solution for bridge decks. Two bridge decks on I-215 were selected as test sites. TechCrete® patches were installed on these decks, and monitored over the space of four years.

The objectives of the test were to evaluate the speed and ease of product installation and to observe the durability of the product over four years.

During the time of the study, observations showed that despite the degradation of surrounding concrete, the TechCrete® patch remained in place with no observable degradation within the patches themselves. However, spalling in existing concrete near the TechCrete® has raised questions about the effects on surrounding materials.

Further study is recommended to more fully determine the impact of TechCrete® patches on the degradation of surrounding materials. These studies should include testing for the effects of stress concentrations caused by saw cutting, differences in the thermal coefficients of TechCrete® and the concrete at the sites, research and testing for “incipient anode” conditions, and observations of previously installed TechCrete® patches. Data should also be collected on previously installed TechCrete® to determine whether similar spalling has occurred on those sites.

In accordance with current UDOT bridge deck rehabilitation practices, future TechCrete® patches should also be overlain with a waterproof membrane and an asphalt patch per specifications. Future patches should also be observed and documented quarterly through the lifetime of any studies they are involved in.

1.0 INTRODUCTION

UDOT highway bridge decks are subject to constant dynamic loading and freeze/thaw cycles over their lives. These and other factors can cause concrete decks to spall. A new patching product, TechCrete®, by Crafcro (www.crafco.com), a hot pour, rapid-set polymeric material, had performed well on I-15 concrete pavement as documented in the report on Experimental Feature No. X(03)07. The decision was made to install and evaluate TechCrete® as a potential bridge deck spall repair product.

As part of UDOT's product evaluation process, product information was sought and received from the supplier via the "Preliminary Information for Product Evaluation" (R-52) form. (Appendix D). Attachments to the R-52 form that give more information about safety, handling, installation, etc. are shown appendices B,C,E and G.

Two bridges on the north bound I-215 off ramp to I-80/Redwood Road were selected for the study. Structure number C-699 (Fig. 1) over the Union Pacific Railroad line at mile post 21.8 is a continuous span steel girder bridge built in 1987. Structure number C-701 (Fig. 1) over the I-80 east bound off ramp at mile post 22.2 is a continuous span steel girder bridge built in 1985. The 2007 AADT and truck counts for the I-215/I-80 interchange were reported as being, respectively, 60,405 and 14%.

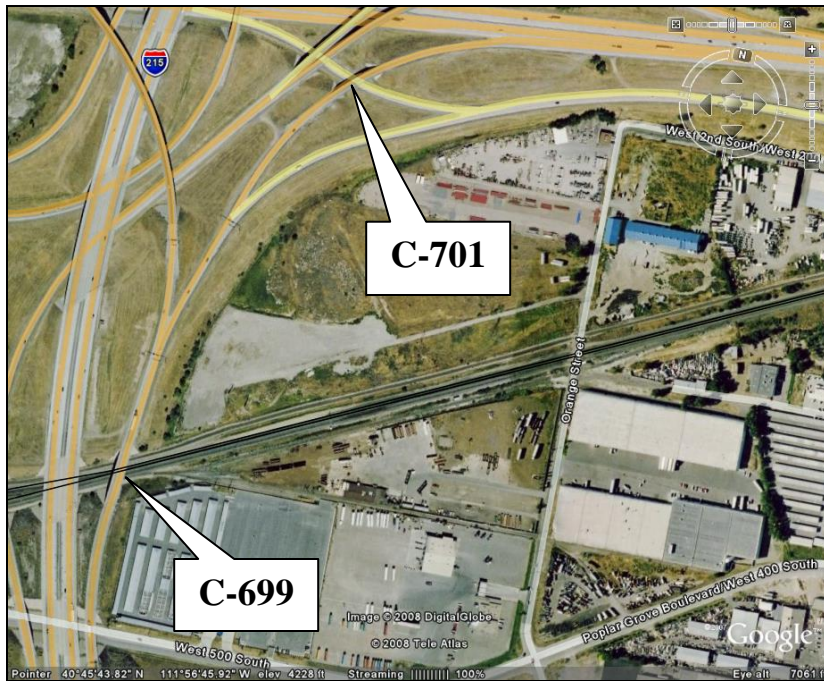


Figure 1: Location Map

To facilitate observation, maintenance crews monitored the product's performance over the prescribed time period. Research Division personnel also made periodic checks on the sites, and took photographs to illustrate the product's performance.

2.0 OBJECTIVES

The objectives of the test were to evaluate the speed and ease of product installation and to observe the durability of the product over four years. The methods used to evaluate the speed and ease of product placement included documenting the installation, and periodically returning to site to observe the durability of the patches.

3.0 METHODS

The following items were part of the research procedure:

Recording date of installation

Recording the entities involved in the various aspects of the installation

Recording the area(s) affected

Clean up procedures, before, during, and after installation

Documentation of the installation and performance in photographic format

Plan to visit the sites regularly to visually inspect and assess the performance of the product, etc.

4.0 INSTALLATION AND COST

4.1 Cost calculations

Three patches were installed in August 2004. The patch on structure C-699 covered a 12'x14' area. Two smaller patches on structure C-701 covered 3'x 2' and 4'x 5' areas.

In order to cover these three areas, 2750 lbs of polymer, five gallons of primer, and six bags of gravel were used. The installed unit cost was estimated at a \$395.95 per cubic foot; (Appendix F).

4.2 Installation procedure

The installation of the 12' x 14' patch on structure C-699 is outlined below. The referenced figures correspond to the photographs shown in Appendix A. CrafcO's installation instructions are shown in Appendix B.

1. Prep work consisted of saw cutting edges and hammering out the delaminated concrete. (Figure 7) Any debris was appropriately removed after hammering (not pictured).
2. Concrete was heated prior to application of the primer. (Figure 8)
3. Primer was brushed in until it completely coated the exposed concrete and steel.(See Figure 9).
4. The edges of the patch area were brushed by hand to ensure coverage.(Figure 10)
5. The initial "plug" was emptied into a bucket and dumped back into the mixer to be reheated. (Figure 11)

6. The polymer began to self-level immediately after being placed with heated spreaders. (Figure 12)
7. The corners of the patch area were worked into place. (See Figure 13)
8. The polymer set quickly as it cooled, making it hard to place a large area at once. (Figure 14)
9. The polymer was reheated with a propane torch as needed for greater workability. (Figure 15)
10. The polymer was also heated to help eliminate the last bubbles, and to warm the surface for the application of the sand. (Figures 16 & 17)
11. The sand was patted into place to assure bonding. (Figure 18)

5.0 DATA COLLECTION

The patch on the deck of Structure C-701 was placed at midspan, and is subject to the greatest flexural forces of the three patches, making it the most likely to incur spalling around the patch. The photographs below illustrate the progression of spalling on the 4'x5' patch on C-701.

5.1 Results of On-going Observation

5.1.1 Spring 2005

The photos in Figures 2 and 3, taken in the spring of 2005, show that the patch was intact, with no evidence of degradation. (See Figures 2-3)

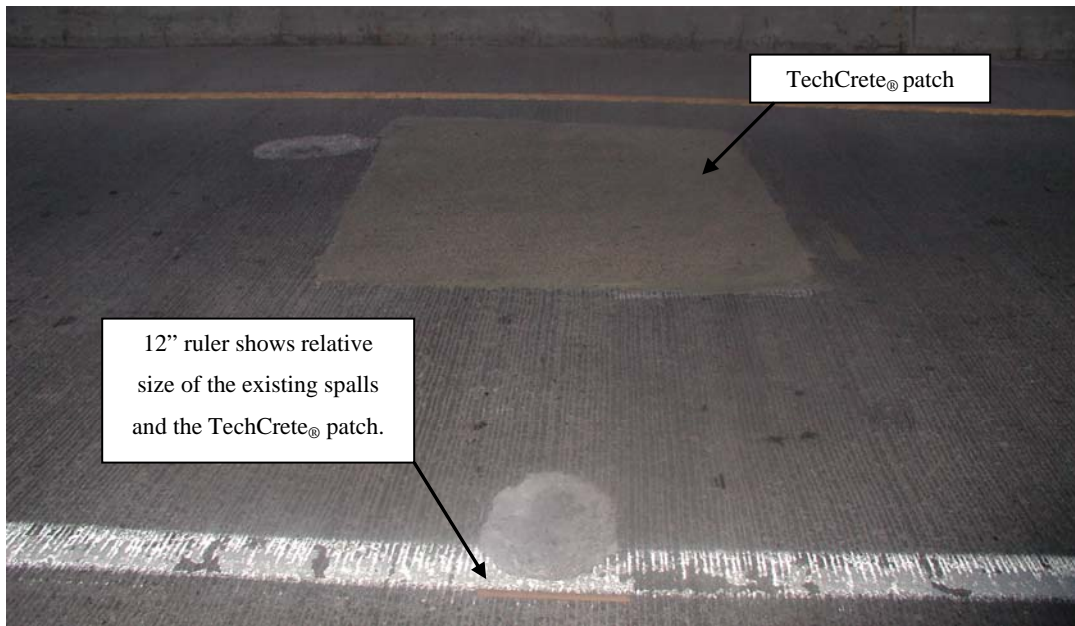


Figure 2: Patch is intact with no evidence of degradation.

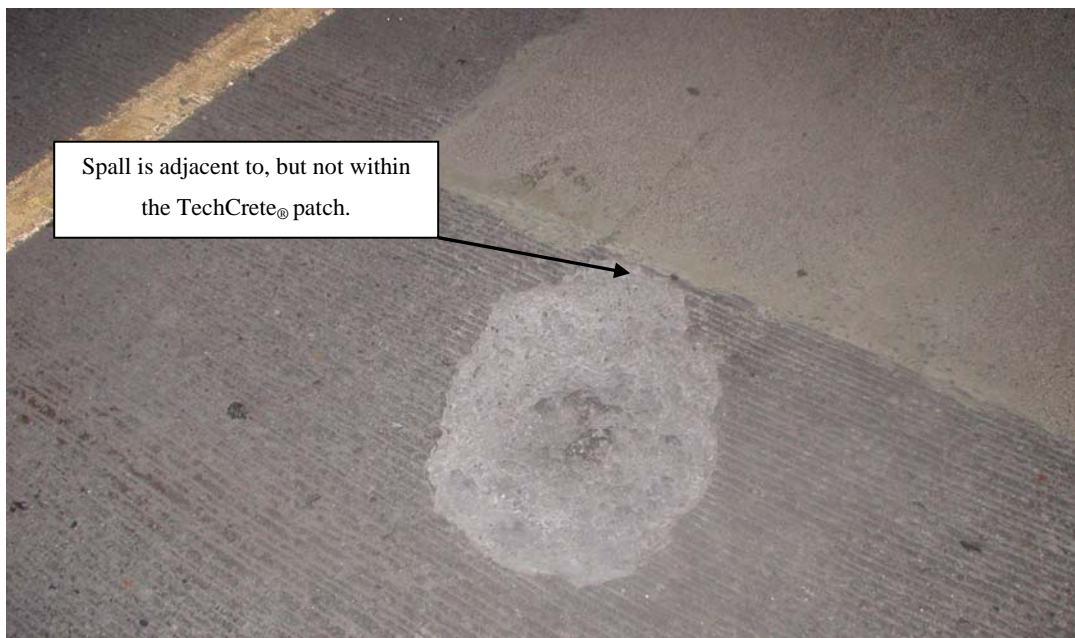


Figure 3: Research personnel observed spalling adjacent to the patch.

5.1.2 June 2007



Figure 4: TechCrete® patch continued to show no observed signs of deterioration.



Figure 5: Research Personnel observed increased spalling adjacent to, but not intrusive on the TechCrete® patch.

5.1.3 June 2008

In June 2008, the TechCrete® patch was still bonded to the underlying concrete, despite the obvious damage to existing concrete in the surrounding area. Maintenance crews have applied crack seal and asphalt patching material to surrounding spalled areas. Researchers observed that the size of the spalled area grew with time, but have yet to reach any conclusions as to why the spalling increased. (See Figure 6)



Figure 6: TechCrete® remains bonded despite surrounding spall damage.

6.0 DATA EVALUATION/ANALYSIS

As mentioned in Section 5.0, the data was purely qualitative. Analysis techniques were limited to visual inspections, though metrics for concrete spalling exist. (see Figure 2, and note the 12" ruler placed for scale).

The primary criterion used in data analysis was the amount of deterioration witnessed in the TechCrete® patch, of which there appeared to be none.

6.1 Region Feedback on the Product

At the request of the Research Division, Region personnel submitted feedback on the TechCrete® material on 12 August, 2008; (Appendix H)

.

The first comment concerned the increased spalling around the TechCrete® patch, which represented an increased expense that the maintenance sheds had not planned on, and which impacts their budgets.

Region feedback also indicated that TechCrete® required a larger capacity machine than other patching products, in order to keep installation speed at a level they could consider reasonable. They also felt that too much time was required to heat the materials, compared to other patching products, which can result in increased installation costs.

Region personnel observed that the sand applied in the final steps of the TechCrete® installation had worn off, leaving bald spots on the patches. Additionally, heating the material before applying sand or at other stages of the installation process posed a risk of igniting the polymer. This requires additional safety precautions be taken. The MSDS indicates an NFPA combustibility rating of IIIB; (Appendix C).

The Research Division was also informed that the self-leveling properties of TechCrete® only applied to flat surfaces. When using TechCrete® on a spot with super-elevation, more effort would be required to keep the material level.

6.2 Spalling of surrounding concrete

Spalling of surrounding concrete was not anticipated in this study. The data was not sufficient to determine if or how the patch on C-701 affected the surrounding concrete, though several ideas were discussed as possible causes for the issue. The increased spalling surrounding the patch could be due to a phenomenon known as the “incipient

anode effect.” Information about this effect is published by the Corrosion Engineering Journal at the following url:

http://www.corrosionsource.com/corrosionengineering/journal/Jul02_Qui/Jul02_Qui_4.htm

The article referenced above is entitled “Pre-Packaged Zinc Sacrificial Anode.” The opening paragraph in the article states, “Conventional patch repair of corroded concrete structures inevitably introduces ‘incipient anode’ effect due to the different electrochemical behavior of the ‘new’ and ‘old’ rebar/cement. The newly patched area had a higher potential than the neighboring area (which may still be contaminated with chloride), and is the cathode in the corrosion process, while the rebars in the neighboring areas become the anode and start to corrode. Conventional patch repair treats only the symptoms, but the cause and the incipient anode effect makes this repair a never-ending process.”

Differential thermal coefficients and stress concentrations are other possible reasons for the spalling near the patch. If the thermal coefficient of the concrete is sufficiently different from the thermal coefficient of the TechCrete, freeze/thaw cycles could create stresses around the edges of the TechCrete® patch that would spall the concrete.

Saw cutting of concrete creates stress concentrations that can cause spalling.

It is also possible that non-visible damage, beneath the surface of the patch, may have caused spalling.

7.0 CONCLUSIONS

Observation of the site showed that the TechCrete® patch bonded to deck, and stayed in place with no observed degradation. Spalling occurred around the patch, however, and appeared to deteriorate continually over the study period.

8.0 RECOMMENDATIONS AND IMPLEMENTATION

8.1 Recommended practices

Further investigation is recommended to help determine how TechCrete® patches impact surrounding materials. Such investigations should include studying the effects of differing thermal coefficients of TechCrete® and concrete, studying the impacts of stress concentrations created by saw cutting, testing for “incipient anode” conditions, and observations of previously installed TechCrete® patches.

Future patches should be monitored quarterly to observe the progression of any surface damage.

8.2 Current practices

Chris Potter, Deputy Bridge Operations Engineer, was consulted with regards to this study. He related that deck corrosion and spalling occur because air, water, and chlorides are present in affected areas. Waterproof membranes eliminate the water from the equation, thus preventing corrosion.

UDOT's current standard deck patching practice involves pothole patching, followed by the application of a waterproof membrane and an asphalt overlay; (Appendix I). Chris believes that this simple addition of a waterproof membrane and asphalt may be sufficient to pre-empt the kind of spalling observed around the TechCrete patches.

Any future applications of TechCrete patches should involve the use of such a waterproof membrane, per standard practice.

APPENDIX A: INSTALLATION PHOTOGRAPHS

The following photographs document the installation steps taken for the 12' X 14' patch on structure C-699 and are typical of the steps taken for the installation of the other patches.



Figure 7: Prep work consisted of saw cutting edges and hammering out the delaminated concrete.



Figure 8: Concrete was heated prior to application of the primer.



Figure 9: Primer was brushed in until it completely coated the exposed concrete and steel.



Figure 10: The edges of the patch area were brushed by hand to ensure coverage.



Figure 11: The initial “plug” was emptied into a bucket and dumped back into the mixer to be reheated.



Figure 12: The polymer began to self-level immediately after being placed with heated spreaders.



Figure 13: The corners were worked into place.



Figure 14: The polymer set quickly as it cooled, making it difficult to place a large area at once.



Figure 15: The polymer was reheated with a propane torch as needed for greater workability.



Figure 16: Bubbles were present in the hot polymer.



Figure 17: Polymer was heated to pop the last bubbles and warm the surface for the application of the sand.



Figure 19: The sand was patted into place to assure bonding

APPENDIX B: INSTALLATION INSTRUCTIONS



420 N. Roosevelt Ave. • Chandler AZ 85226
1-800-528-8242 • (602) 276-0406 • FAX (480) 961-0513

APPLICATION INSTRUCTIONS

TECHCRETE R AND TBR

PART NO. 34951, 34952, 34953, 34954
34957, 34958, 34290

JUNE, 2001

READ BEFORE USING THIS PRODUCT

GENERAL: Crafco TechCrete R and TBR materials include the following: TBR Cold Climate (#34958), TBR Standard Climate (#34953), TBR Hot Climate (#34954), R Cold Climate (#34957), R Standard Climate (#34952), R Hot Climate (#34951) and Primer (#34290). TechCrete materials are hot-applied, synthetic resin compounds containing chopped glass fiber, polymer rubber and aggregate. For repairs 1 9/16" (40mm) in depth or greater the appropriate TechCrete TBR should be applied, for repairs less than 1 9/16" (40mm) in depth the appropriate TechCrete should be applied. Additional information on the products is shown on Product Data Sheets.

MELTING: Ensure the heater/mixer is clean and free of any residual material or contamination. The initial heat-up should be a minimum of 400 pounds. Do not remove TechCrete material from the bag. Place bag and material into TechCrete mixer/heater for melting. Do not mix different types of TechCrete materials together. Heat TechCrete material to a minimum application temperature of 375°F (190°C). Do not exceed the safe heating temperature of 428°F (220°C). Do not heat TechCrete materials continuously for longer than six (6) hours.

PAVEMENT TEMPERATURES: Do not apply TechCrete material if the pavement temperature is below 40°F (4°C).

PAVEMENT PREPARATION: Erect appropriate traffic controls to protect the work site for the duration of the repairs. Mark out the area to be repaired and use suitable equipment (saws, planers, pneumatic hammers, etc.) to remove the defective pavement. Sufficient pavement is to be removed to ensure the TechCrete is bonding to sound intact pavement. Remove all loose debris from the work site. Clean and dry the repair area with a hot air lance. Prime the repair area with the primer (part number 34920) and allow the primer to set (dry) before applying the TechCrete material. The perimeter of the repair area is to be masked with a fabric tape to ensure no excess material will be on the surface of the pavement.

APPLICATION: Gravity feed the TechCrete material directly into the repair area or into pails and immediately pour into the repair area. For repairs 1 9/16" (40mm) in depth or greater the appropriate TechCrete TBR should be applied, for repairs less than 1 9/16" (40mm) in depth the appropriate TechCrete should be applied. TechCrete TBR material should be applied in two (2) applications (lifts). Allow the material to cool between each application (lift). Work the TechCrete material into the edges of the repair and level surface with a heated iron. Allow bubbles to expell from the applied TechCrete material. Prior to applying the aggregate dressing, quickly expose the surface of the TechCrete material to a flame to remove any surface bubbles. While the TechCrete material is still hot, apply a dressing of dry aggregate chipping (part number 34950) to the surface of the repair. Once the TechCrete material has cooled a final cleaning (sweeper/vacuum) will remove any surplus Bauxite prior to opening to traffic.

CLEAN OUT: Remove all excess material from the mixer/heater at the completion of each days repair.

STORAGE: Pallets of bagged product are protected with a weather resistant covering. During storage, the protective wrap must be kept on the pallets to prevent bags from getting wet. If bags are subjected to moisture, the material may get wet which could create displacement (boil-over) of the product from the tank during heat-up. If rips in the pallet covering occur during handling, they should be repaired to help maintain packaging integrity. Pallets should be stored on a level surface which is dry and has good drainage. Pallets should not be stacked. Material properties are not affected by packaging deterioration.

SAFETY PRECAUTIONS: Since these materials are heated to elevated temperatures, it is essential that operations be conducted in manners which assure safety of personnel. All associated with use of the material need to be aware of the hazards of using hot applied materials and safety precautions. Before use, the crew should read and understand product use and safety information on each bag of TechCrete and the product MSDS. This sheet which is supplied with each shipment, describes the characteristics of the product as well as any potential health hazards and precautions for safe handling and use. User should check D.O.T. requirements for transportation of TechCrete at elevated temperatures above 212°F (100°C).

HAZARDS ASSOCIATED WITH HOT APPLIED MATERIALS: Skin contact with hot applied materials causes burns. Over exposure to fumes may cause respiratory tract irritation, nausea, or headaches. Appropriate precautions need to be taken to prevent contact with the hot material and to avoid inhalation of fumes for everyone in the vicinity of the work area operation. Safety precautions should include: 1. Protective clothing to prevent skin contact with hot material. 2. Care when adding product to melters to reduce splashing. 3. Careful operation and control of tools which are used to apply product. 4. Traffic and pedestrian control measures which meet or exceed local requirements to prevent access to work areas while product is still in a molten state. 5. Avoidance of material fumes. 6. Proper application configurations with a minimum amount of excesses of material. 7. Appropriate clean up of excessive applications or product spills.

ADDITIONAL INFORMATION: Additional information regarding these products is available by contacting your distributor or Crafco, Inc. This information includes: 1) Product Data Sheets, 2) Material Safety Data Sheets and 3) Safety Manual.

TechCrete Placement

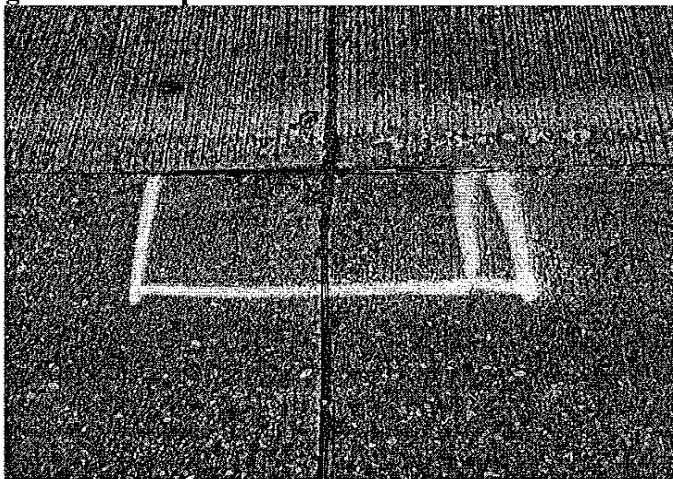
Prior to the material application you will need to have the equipment ready and organize the work area.

The following items should be on the job site.

1. Compressor
2. Saw to cut out repairs
3. Pneumatic Hammer
4. Broom and shovels to clean up area
5. Broom or Sweeper (if required to remove FOD)
6. TechCrete Machine, Material and Application Tools
7. Dressing Stone
8. Heat Lance
9. Primer
10. Hudson Sprayer for the Primer
11. Paint Brushes
12. Small Paint Cans
13. Rags
14. 1 or 2 Gallons of Water (to speed the cooling process if required)
15. Gloves, Heavy Welder Gloves and Std. Leather Gloves
16. Cloth Duct Tape
17. Reference Materials

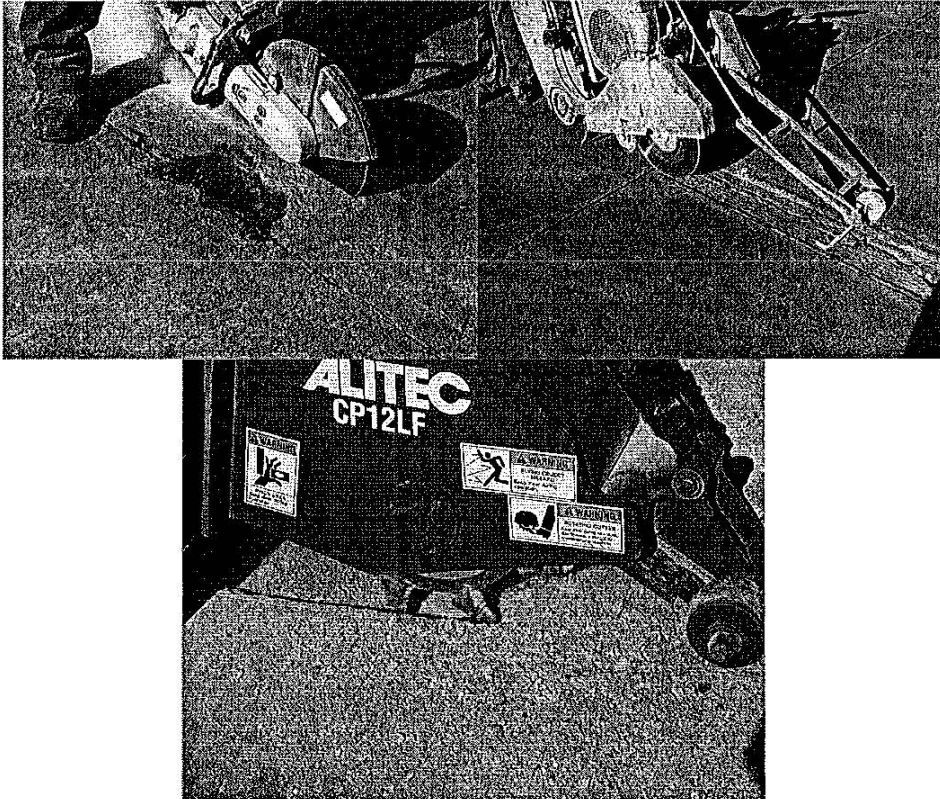
Application Steps

1. Locate areas to be repaired,
2. Mark the areas to be cut out. Make sure you cut out enough of the pavement to remove all cracking around the patch area.



CONSISTENT AND DEPENDABLE SERVICE AND PRODUCTS
TO SATISFY THE CUSTOMER AND OUR COMPANY'S GOALS

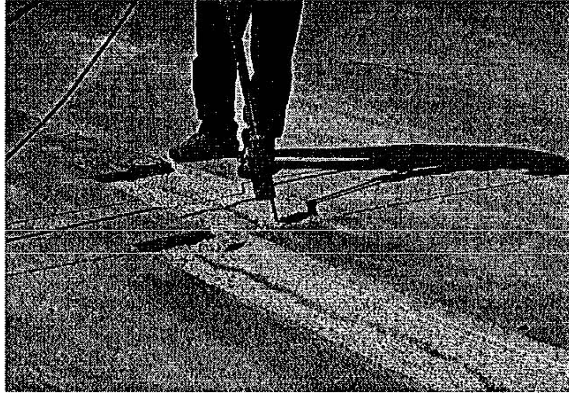
3. This can be done with either a wet / dry saw or milling operation. The saw should cut a minimum of 1 ½" to 2" deep.



4. Remove the remaining material with a chipping hammer or jack hammer so that the walls of the area to be patch are free of any contamination and vertical to a minimum depth of 1 ½" to 2".



5. After the repair area has all of the loose material removed use the hot air lance to clean and dry the pavement.



6. Apply tape 1/4" from the edge of the prepared area.



7. Prime the area with the TC Primer. Use the Hudson sprayer or paint brushes to apply the primer. If spraying the primer on the repair area you may need to do some touch-up with a paintbrush. When touching up the primer you want to cover any missed spots and spread any pooled primer around. Allow the primer to set up. This should take 10-12 minutes. Do not try to dry with a torch



Application of the TechCrete

During the time you have been preparing the patch areas you should have calculated (see calculation chart) the amount of material needed for the repairs. Place bags of material in the melter and heat. Start the agitator as soon as possible to break up the bags. The heat up time is very fast usually with-in 60 to 90 minutes. Care should be taken not to overheat the material. If material temperature is too high lower burner temperature control and/or open the lid to cool down. The minimum amount of material needed to heat the unit is 400 pounds.

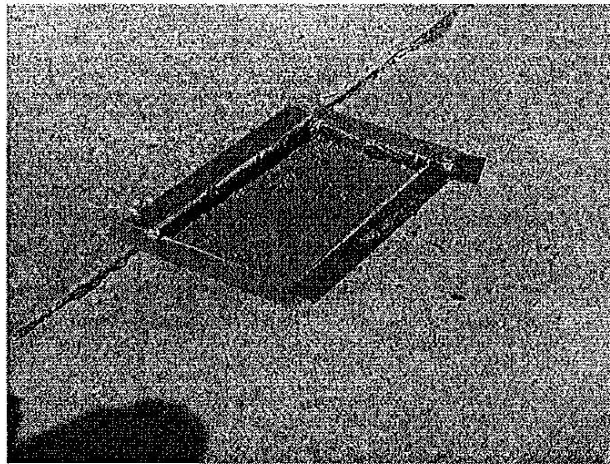
1. Have the tools heating.
2. Heat the discharge gate



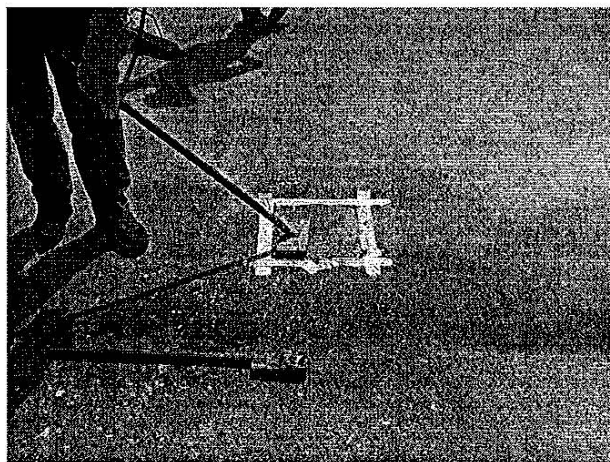
3. Remove at-least two pails of product and pour back into the melter. This will ensure a good flow of material when you start the application.



4. Apply the first lift of material into your repair. Apply enough material so you get material with-in 1" of the surface of the pavement.



5. Allow the material to cool for a period of time sufficient enough to let the air bubbles move to the surface of the TC. The bubbles are generated from trapped air during the pouring operation, moisture, or uncured primer. When the bubbles stop rising to the surface (usually 15-20 min.) flash the surface of the material to pop any bubbles.
6. Apply the second lift (final lift) and float (level) with the hot irons. Sealing the edges of the repair by pulling liquid material to the edge and removing the Duc Tape as soon as you work the material to the edge; B) Making sure you do not have too much material in the patch. The main portion of the material will self level, you may need to do some smoothing with the hot iron to insure a level surface.



7. Allow cooling similar to the first lift. You should not experience as many bubbles this time but some may still appear. When they do flash them with the torch.
8. Apply the aggregate dressing material immediately after the surface is flashed. If the aggregate dressing is damp or wet it will not adhere to the TechCrete material well. Dry the aggregate dressing prior to placing on the TechCrete material. Smooth the aggregate dressing over the patched area with your gloved hand. This allows you to insure coverage of the whole surface of the TC. If you applied the aggregated dressing too soon the bubbles will continue to rise to the surface and pop. This will leave a pot-marked surface not a smooth surface. If this occurs adjust your timing to allow more bubbles to break the surface of the TC. If you notice some aggregate dressing lose after the TechCrete material cools you will need to heat the Aggregate dressing prior to applying on the TechCrete material to remove any moisture in the aggregate.



9. Shut down the melter and clean up the area while you wait for the TC to cool enough to handle traffic. If you need to speed the cooling time up use some water broadcast over the surface.
10. Sweep the excess aggregate dressing material from the surface of the repair and finish the clean up.

HOT APPLIED PCCP SPALL REPAIR MATERIAL PLACEMENT

1. DESCRIPTION

- 1.1 Crafcro TechCrete (Type TBR) is a hot applied polymer modified resin based flexible concrete repair material. Used to repair cracks, spalls, pop-outs, failed joints and most types of defects in concrete surfaces up to a maximum depth of 8 inches (200 mm). TechCrete is gray in color, similar to the surfaces in which it is to be applied, therefore it is aesthetically suitable in all concrete pavements. The unique design features of TechCrete produce an impervious, impact resistant, load bearing, highly flexible repair that withstands vehicle traffic, aircraft movements and climatical conditions once installed. Installing relieve joints at adjacent slabs is not required with Techcrete. TechCrete is supplied in powder form in melt pack bags. The material is carefully placed, complete with bag, in the TechCrete Melter Mixers, melted and heated to the correct working temperature. The melted material is then poured into the prepared pavement section and leveled. The repair is left to cool and solidify prior to opening to traffic.

2. MATERIAL SPECIFICATIONS

Material for this project shall be: TechCrete TBR Standard.

2.1 Properties of TechCrete Type TBR are as follows:

<u>Parameter</u>	<u>Cold</u>	<u>Standard</u>	<u>Hot</u>
Temperature ranges	68°F (20°C) to -13°F (-24°C)	80°F (28°C) to 24°F (-5°C)	140°F (60°C) to 40°F (5°C)
Color	Gray	Gray	Gray
Form	Powder	Powder	Powder
Specific Gravity	2	2.2	2.2
Softening Point, ASTM D36	185°F (85°C) (min.)	230°F (110°C) (min.)	239°F (115°C) (min.)
Flow Test (5 hrs @ 140°F (60°C)) ASTM D3407/BS2499	3 mm (max.)	3 mm (max.)	3 mm (max.)
Slump Test (cone) 3 hrs @ 158°F (70°C)	5% (max.) BS3262 Part 1	5% (max.) BS3262 Part 1	5% (max.) BS3262 Part 1
Penetration Test @ 77°F (25°C)	7.5 mm (max.)	-	-
Extension Test @ 19°F (-7°C) extension	100% ASTM D3405	-	-
Extension Test 1 mm/min. @ 77°F (25°C)	-	ASTM D5329	ASTM D5329
Newton Force Extension	-	650 N (max.) 50% (min.)	650 N (max.) 25% (min.)
Compression Resistance 10 mm/min. @ 73°F (23°C)	5000 Newton load (min.) @ 25% compression	5000 Newton load (min.) @ 25% compression	5000 Newton load (min.) @ 25% compression
Wheel Tracking @ 122°F (50°C) mm/hr	40 mm specimen 3mm/hr (max.) (BS598-110:98)	40 mm specimen 3mm/hr (max.) (BS598-110:98)	40 mm specimen 3mm/hr (max.) (BS598-110:98)
Max rut depth	5 mm (max.)	5 mm (max.)	5 mm (max.)
Binder Extension Test, 2.5 mm/min. @ 72°F (22°C), Newton force	350 N (max) ASTM D5329	-	-
Extension	700%	-	-
Binder Extension Test, 1 mm/min. (5 cycles) @ 72°F (22°C) Newton force	-	Single extension 400 N (max.) ASTM D5329	550 N (max.) ASTM D5329
Extension	-	300% (min.)	50% (min.)
Artificial Weathering	1000 hrs (min.) BS3900/part F3	1000 hrs (min.) BS3900/part F3	1000 hrs (min.) BS3900/part F3

De-icer Fluid	Resistant	Resistant	Resistant
Min. Application Temp.	375°F (190°C)	375°F (190°C)	375°F (190°C)
Max. Application Temp.	428°F (220°C)	428°F (220°C)	428°F (220°C)
Shelf Life	2 years	2 years	2 years

3. REQUIRED EQUIPMENT

- 3.1 The following equipment is required: minimum 100 CFM air compressor, concrete saws (wet or dry), pneumatic hammer, TechCrete melter applicator, approved aggregate dressing, heat lance, primer, primer applicator (Hudson sprayer), paint brush, cloth duct tape, clean up tools, proper safety equipment for working with hot molten materials and other miscellaneous tools to complete the process.

4. SURFACE AND MATERIAL PREPARATION

- 4.1 Material: Place bags of material in the melter and heat. Follow proper operating procedures provided for applicator. Start the agitator as soon as possible to break up the bags. Once material is at the recommended application temperature of 375°F (190°C) to 428°F (220°C) for 15 minutes application can begin. Care should be taken not to overheat the material. The minimum amount of material needed to heat the unit is 400 pounds (180 kg). Maximum amount of material that can be heated is +/- 1000 pounds (454 kg).
- 4.2 Surface: Locate areas to be repaired.
- 4.3 Mark the areas to be cut out. Make sure all deteriorated pavement is marked and removed.
- 4.4 When TechCrete TBR is applied across a joint a minimum of 4" (102 mm) of material is required to be placed into the adjacent slab.
- 4.5 Cut out the marked areas with a wet or dry saw. The cut should be a minimum of 1 ½" (38.1 mm) deep.
- 4.6 Remove all the damaged concrete material with pneumatic hammer so that the walls and bottom of the area to be patched are free of any contamination or deteriorated pavement.
- 4.7 Remove all loose material. Blow out the area to be patched with hot compressed air using the hot air lance to clean and dry the pavement.
- 4.8 Apply tape on the pavement surface ¼" (6.35 mm) from the edge of the prepared area.
- 4.9 Use the sprayer or paint brushes to apply the primer to prepared areas. Spread primer evenly throughout the work area with brush if necessary to prevent puddles or bare spots. Allow the primer to set up for 10 –12 minutes. Do not dry primer with a heat or flame.

5. APPLICATION

- 5.1 Tools shall be heated in heating box provided with applicator.
- 5.2 Heat the discharge gate.
- 5.3 Purge the applicator by removing at least two pails of repair material and pour back into the melter.
- 5.4 Apply the first lift of material into the repair. In deeper repairs apply material in maximum 2" (51 mm) lifts. On the next to the last lift apply material to within ½

- to 1" (12.7 to 25.4 mm) of the surface of the pavement. Between layers allow the material to cool for a period of time sufficient to let the air bubbles move to the surface of the material. The bubbles are generated from trapped air during the pouring operation or moisture. When the bubbles stop rising to the surface (usually 15-20 min.) flash material surface with torch to remove all bubbles.
- 5.5 Apply the final lift and float (level) with the preheated irons. Seal the edges of the repair by pulling liquid material to the edge. Remove the tape as soon as the material is worked to the edge. Make sure material is level with surrounding pavement surface. Smooth the surface with the hot iron to ensure a level surface.
- 5.6 Allow material to cool for 15 to 30 minutes. If bubbles appear flash them with the torch.
- 5.7 Heat and dry the approved aggregate dressing in metal pail prior to placing on the TechCrete material.
- 5.8 Apply the heated and dried aggregate dressing a minimum of ¼" (6.35 mm) thick evenly over the entire surface of the material immediately after the surface is flashed. Smooth the aggregate dressing over the patched area to assure uniform coverage.
- 5.9 Once the repair material has cooled and set up (generally 30-60 minutes) remove excess aggregate dressing from the surface of the repair.
- 5.10 Clean excess material from repair areas.
- 5.11 Allow repair material to cool and test for set up before trafficking. Generally 30-60 minutes is sufficient cooling time, but deeper repairs will require additional set up time.

6. PAYMENT

- 6.1 The Department will make payment for the completed and accepted quantities under the following:

<u>Pay Item</u>	<u>Pay Unit</u>
TechCrete	Square Foot

APPENDIX C: MSDS SHEET



Material Safety Data Sheet

Date of Preparation: 05/30/03

Section 1 - Chemical Product and Company Identification

Product Name: TechCrete Type R and TechCrete Type TBR
Chemical Family: Resin, Polymer and Aggregate Blend
Chemical Formula: Mixture
CAS Number: Mixture
Manufacturer: Roadtechs Europe Limited, Mid Suffolk Business Park, Eye, Suffolk, IP23 7HE, England, UK, +44 (0) 1379 872550
Supplier: Crafcro, Inc. 420 N. Roosevelt Ave., Chandler, AZ, 85226 USA

EMERGENCY TELEPHONE Numbers: 1(602) 276-0476 Normal Business Hours
 Chemtrec 1(800) 424-9300 After Business Hours

Section 2 - Composition / Information on Ingredients

Ingredient Name	CAS Number	% wt.
Aromatic hydrocarbon resin	68527-25-3	-
Styrene butadiene styrene	9003-55-8	-
Napthenic oil	64742-59-2	-
EVA olefin/ester copolymer	24937-78-8	-
Silica	14808-50-7	-
Calcium carbonate	1317-65-3	-
Granite aggregate	Not applicable	-

Ingredient	OSHA PEL		ACGIH TLV		NIOSH REL		NIOSH
	TWA	STEL	TWA	STEL	TWA	STEL	IDLH
Aromatic Resin	N.E.	N.E.	N.E.	N.E.	N.E.	N.E.	N.E..
SBS	N.E.	N.E.	N.E.	N.E.	N.E.	N.E.	N.E.
Napthenic oil	N.E.	N.E.	N.E.	N.E.	N.E.	N.E.	N.E.
EVA copolymer	N.E.	N.E.	N.E.	N.E.	N.E.	N.E.	N.E.
Silica	See Sec. 8	N.E.	0.1 mg/m3	N.E.	N.E.	N.E.	N.E.
Calcium carbonate	15 mg/m3	N.E.	10 mg/m3	N.E.	N.E.	N.E.	N.E.
Granite aggregate	N.E.	N.E.	N.E.	N.E.	N.E.	N.E.	N.E.
N.E.- none established							

Section 3 - Hazards Identification

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Potential Health Effects

Primary Entry Routes: Inhalation, skin, and eye contact

Inhalation: Inhalation of mists, vapors or fumes may irritate respiratory tract.

Eyes: Exposure to mists vapors or fumes may cause irritation. Direct contact with hot material will cause thermal burns and possible blindness.

HMIS
 H 1
 F 1
 R 0

PPE†
 †Sec. 8

Skin: Direct contact with hot material will cause thermal burns. Prolonged exposure may cause irritation.

Ingestion: None expected. Ingestion of hot material will cause thermal burns. Ingestion may cause gastrointestinal disturbances, irritation, nausea, vomiting, blockage and diarrhea

Carcinogenicity: This product contains crystalline silica. Silica is a known carcinogen; however in this encapsulated form the normal routes of exposure are unavailable. The National Toxicology Program (NTP) has determined that respirable crystalline silica may reasonably be anticipated to be a carcinogen, based upon animal studies. The International Agency for Research on Cancer (IARC) classified crystalline silica inhaled in the form of quartz cristabolite from occupational sources as Group 1- carcinogenic to humans. Napthenic oil contains polycyclic aromatic hydrocarbons which upon prolonged contact may cause cancer of the lungs and skin.

Medical Conditions Aggravated by Long-Term Exposure: Pre-existing skin disorders and eye problems.

Section 4 - First Aid Measures

Inhalation: Remove to fresh air. If not breathing, get immediate medical attention. Clear airway and start mouth-to-mouth artificial respiration (if trained and certified) or use a bag-mask respirator. If victim is having trouble breathing, transport to medical care and, if available, give supplemental oxygen.

Eye Contact: Do not rub eyes. Flush thoroughly with water. Seek medical attention if irritation develops and persists. If hot material contacts eyes, flush continuously with water and seek medical attention.

Skin Contact: Wash skin areas with plenty of water and soap. Seek medical attention if irritation develops and persists. If hot material contacts skin, cool affected area with cool water. Do not attempt to remove cooled material from skin as the damaged skin may be easily torn. Do not use solvents. Seek medical attention.

Ingestion: Give 3-4 glasses of water, but do not induce vomiting. If vomiting occurs, give fluids again. Get medical attention to determine whether vomiting or the evacuation of the stomach is necessary. Do not give anything by mouth to an unconscious person.

Section 5 - Fire-Fighting Measures

Flash Point: >445F (>230C)

Autoignition Temperature: Not determined

Lower Explosive Level (LEL): Not determined

Upper Explosive Limit (UEL): Not determined

Flammability Classification: III B Combustible

Extinguishing Media: Carbon Dioxide, foam, dry powder, and water fog. DO NOT USE WATER JET.

Unusual Fire or Explosion Hazards: This product may ignite when sufficient heat is applied. Smoke from fire may be hazardous.

Combustion Product: Fire may produce hazardous decomposition products.

Fire-Fighting Instructions and Equipment: Use of foam or water may cause frothing. This statement applies to liquids having flashpoints above 212F and is included only as a precaution... It does not indicate that water or fire-fighting foam should not be used. The frothing may be violent and could endanger fire fighters located too close to the burning liquid, particularly when solid streams of water are directed onto the hot, burning liquid. A carefully applied water spray has been used to achieve extinguishment by deliberately causing frothing on the surface of the liquid; the foaming action blankets the surface of the liquid and extinguishes the fire by excluding oxygen. Do not release runoff from fire control methods to sewers or waterways. Use a water spray to cool fire-exposed containers. Use self-contained breathing apparatus in enclosed areas where heavy smoke may occur.



Section 6 - Accidental Release Measures

Spill /Leak Procedures: Stop spill at source. Confine spill by diking or impoundment. Remove sources of heat or ignition. Allow material to cool and scrape up material for disposal. Clean-up spill but do not flush to sewer or surface water. Ventilate area and avoid breathing mists, vapors or fumes. Notify local health and pollution control agencies as appropriate. Follow applicable OSHA regulations (29 CFR 1910.120). For disposal follow all Federal, State and local regulations regarding solid waste.

Section 7 - Handling and Storage

Handling and Storage Precautions: Wear appropriate protective equipment (see Section 8). Avoid contact with eyes, skin and clothing. Wash thoroughly after handling. Keep material dry and avoid extremes of temperature. Keep unused product in original containers. Keep away from sources of ignition.

Section 8 - Exposure Controls / Personal Protection			
<p>Engineering Controls: Use engineering controls to reduce air contamination to permissible exposure limits and/or threshold limit values (Section 2).</p> <p>Eye / Face Protection: Wear approved safety goggles. Wear face shield if there is a risk of splashing hot material.</p> <p>Skin Protection: Wear suitable overalls and gloves; exposed skin must be covered due to risk of splashing.</p> <p>Respiratory Protection: Should not be necessary under normal working conditions. Where high concentrations of mists, vapors or fumes are present or exposure limits are exceeded, wear a respirator that has been selected by a technically qualified person for the specific work conditions.</p>			
Section 9 - Physical and Chemical Properties			
<table border="0"> <tr> <td> <p>Physical State: Solid particles at room temperature. Liquid above the softening point.</p> <p>Appearance: Grey</p> <p>Odor: Not noticeable</p> <p>Odor Threshold: Not determined</p> <p>Vapor Pressure: <1 mm Hg @ 20C</p> <p>Vapor Density (Air=1): >5</p> <p>Specific Gravity (H₂O=1): 1.7-2.0</p> </td><td> <p>Water Solubility: Insoluble</p> <p>Boiling Point: Not determined</p> <p>Melting Point: Not determined</p> <p>% Volatile: Not determined</p> <p>Evaporation Rate: Not applicable</p> <p>pH: Not determined</p> </td></tr> </table>		<p>Physical State: Solid particles at room temperature. Liquid above the softening point.</p> <p>Appearance: Grey</p> <p>Odor: Not noticeable</p> <p>Odor Threshold: Not determined</p> <p>Vapor Pressure: <1 mm Hg @ 20C</p> <p>Vapor Density (Air=1): >5</p> <p>Specific Gravity (H₂O=1): 1.7-2.0</p>	<p>Water Solubility: Insoluble</p> <p>Boiling Point: Not determined</p> <p>Melting Point: Not determined</p> <p>% Volatile: Not determined</p> <p>Evaporation Rate: Not applicable</p> <p>pH: Not determined</p>
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Section 10 - Stability and Reactivity			
<p>Stability: Stable under normal use conditions.</p> <p>Polymerization: Will not occur.</p> <p>Chemical Incompatibilities: Avoid contact with water when material is hot.</p> <p>Conditions to Avoid (Stability): Do not overheat product.</p> <p>Hazardous Decomposition Products: Oxides of carbon and nitrogen, styrene, methyl styrene and toluene.</p>			
Section 11- Toxicological Information			
<p>Carcinogenicity: This product contains crystalline silica. Silica is a known carcinogen; however in this encapsulated form the normal routes of exposure are unavailable. The National Toxicology Program (NTP) has determined that crystalline silica maybe reasonably anticipated to be a carcinogen, based on animal studies. The International Agency for Research on Cancer (IARC) classified crystalline silica inhaled in the form of cristabolites from occupational sources as Group I -- carcinogenic to humans. Napthenic oil contains polycyclic aromatic hydrocarbons which upon prolonged contact may cause cancer of the lungs and skin.</p> <p>Component: Calcium Carbonate</p> <p>Toxic Dose- LD 50: 6450 mg/kg (oral rat)</p>			
Section 12 - Ecological Information			
<p>Ecotoxicity: No data</p> <p>Environmental Transport: No data</p> <p>Environmental Degradation: Biodegradable</p> <p>Soil Absorption: No data</p>			
Section 13 - Disposal Considerations			
<p>Under the Resource Conservation and Recovery Act (RCRA), it is the responsibility of the user to determine, at the time of disposal, whether the material is a hazardous waste according to RCRA.</p> <p>The transportation, storage, treatment and disposal of RCRA waste material must be conducted in compliance with 40 CFR 262, 263, 264, 268 and 270. Disposal can occur only improperly permitted facilities. Check state and local regulations for any additional requirements as these may be more restrictive than federal laws and regulations. Chemical additions, processing or otherwise altering this material may make the waste management information presented in this MSDS incomplete, inaccurate or otherwise inappropriate. Disposal of this material must be conducted in compliance with all federal, state and local regulations.</p>			

Section 14 - Transport Information																
Ambient Temperature Material (solid in package) Proper Shipping Name: Not regulated by DOT Hazard Class: Not Applicable DOT ID No.: Not Applicable DOT Shipping Label: Not regulated by DOT	Hot Material (liquid above 212F) Proper Shipping Name: Elevated Temperature Liquid N.O.S. Hazard Class: 9 Packing Group: PG III Labels Required: Class 9 Placards Required: "HOT" UN 3257															
Section 15 - Regulatory Information																
U.S. Federal Regulatory Information: RCRA Hazardous Waste Number; Not listed RCRA Hazardous Waste Classification (40 CFR 261): This material should not be listed due to characteristics. CERCLA: Not listed CERCLA Reportable Quantity (RQ): This material in its solid form is not a listed hazardous substance and does not have a reportable quantity. However, if spilled into the waters of the U.S., it may be reportable under the Clean Water Act.																
<table style="width: 100%; border: none;"> <tr> <td style="width: 30%;">SARA 311 Categories:</td> <td style="width: 40%;">Immediate (Acute) Health Effects</td> <td style="width: 30%; text-align: center;">Yes</td> </tr> <tr> <td></td> <td>Delayed (Chronic) Health Effects</td> <td style="text-align: center;">Yes</td> </tr> <tr> <td></td> <td>Fire Hazard</td> <td style="text-align: center;">No</td> </tr> <tr> <td></td> <td>Sudden Release of Pressure Hazard</td> <td style="text-align: center;">No</td> </tr> <tr> <td></td> <td>Reactivity Hazard</td> <td style="text-align: center;">No</td> </tr> </table>		SARA 311 Categories:	Immediate (Acute) Health Effects	Yes		Delayed (Chronic) Health Effects	Yes		Fire Hazard	No		Sudden Release of Pressure Hazard	No		Reactivity Hazard	No
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	Delayed (Chronic) Health Effects	Yes														
	Fire Hazard	No														
	Sudden Release of Pressure Hazard	No														
	Reactivity Hazard	No														
EPA/TSCA Inventory: yes																
State Regulations: The following chemicals are listed by specifically listed by individual states, for details on each states regulatory requirements you should contact the appropriate agency in that state. Pennsylvania Right-to-Know- Limestone (calcium carbonate), silica Rhode Island Hazardous Substances List- Limestone (calcium carbonate) Minnesota Right-t-Know- Limestone (calcium carbonate), silica Massachusetts Right-to-Know- Limestone (calcium carbonate), silica, napthenic oil, carcinogen extraordinarily hazardous Florida Hazardous Substance List- silica New Jersey Right-to-Know- silica Texas Air Contaminants with Health Effects Screening Level Illinois Toxic Substance Disclosure to Employees List California State Superfund Hazardous Substance California Proposition 65 Carcinogens or Reproductive Toxins List: This product contains a chemical known to the Sate of California to cause cancer, birth defects or other reproductive harm.																
Other Regulations: none known																
Foreign Inventories: Canadian HMIS																
Section 16 - Other Information																
<table style="width: 100%; border: none;"> <tr> <td style="width: 30%;">NFPA Hazard Rating</td> <td style="width: 30%;">- Health</td> <td style="width: 40%; text-align: center;">1 Slight</td> </tr> <tr> <td></td> <td>- Fire</td> <td style="text-align: center;">1 Slight</td> </tr> <tr> <td></td> <td>- Reactivity</td> <td style="text-align: center;">0 Least</td> </tr> </table>		NFPA Hazard Rating	- Health	1 Slight		- Fire	1 Slight		- Reactivity	0 Least						
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	- Fire	1 Slight														
	- Reactivity	0 Least														
Prepared By: John Hobbs Phone: 602-276-0476																
Supersedes MSDS Dated: 07/25/01																
Disclaimer: CRAFTCO, INC. PROVIDES THIS INFORMATION FOR THE USER'S CONSIDERATION. CRAFTCO, INC. BELIEVES THE INFORMATION IS ACCURATE, BUT NOT ALL INCLUSIVE, IN ALL CIRCUMSTANCES. USER SHOULD ENSURE THAT USER HAS CURRENT DATA RELEVANT FOR ITS' PURPOSES. NO WARRANTY, EXPRESS OR IMPLIED, INCLUDING MERCHANTABILITY, FITNESS OR OTHERWISE IS GIVEN.																

APPENDIX D: UDOT R-52 FORM



Utah Department of Transportation
Research and Development Division

I.D. FILE # 03-079

PRELIMINARY INFORMATION FOR PRODUCT EVALUATION

Form R-52 (Rev. 2/03)

See instruction block at bottom before starting to fill out form.

1. Product Trade Name: TechCrete Date: 8/20/2003
Manufacturer/Co.: Crafco, Inc. Patented? ☒ Yes ☐ No ☐ Applied For
Company Contact: Not sure Ph#: (602) 276 - 0406 Fax #: 480-940 - 0313
Street Address: 420 N Roosevelt Ave
City: Chandler State: AZ Zip Code: 85226
2. Local Contact: Cate Equipment Co. Ph#: (801) 973 - 2900 Fax #: 973 - 2940
Local Address (Distributor): 2055 S Pioneer Rd
City: Salt Lake City State: UT Zip Code: 84127
3. Background description of Company and its product: Crafco has been the leading manufacturer of Pavement Preservation Products for the past 27 years.
4. Product Identification: TechCrete TBR part #'s 34953, 34954, 34958
5. Recommended use of product: To repair cracks, spalls, pop-outs, failed joints and most types of defects in concrete surfaces up to a maximum depth of eight (8) inches.
6. Outstanding Features or Advantages Claimed: The unique design features of TechCrete produce an impervious, impact resistant, load bearing, highly flexible repair that withstands vehicle traffic, aircraft movements and climatical conditions once installed.
7. General Composition of Material: (Attach laboratory report when applicable) Cement, aggregate, polymer, and resins.
8. When Introduced on Market? 2000 Alternate for what existing product(s)? Concrete patching and repair materials.
9. Approx. cost: \$ 216.00 per cubic foot (unit). Delivery at site 14 days after receipt of order.
If cost is "job-by-job" give typical price range to expect....\$ TO \$.

INSTRUCTIONS -- Answer ALL Questions. Use "X" to indicate choices.
Where a Question is Not Applicable, enter N/A.
Attach additional paper if needed and refer to Item No.

10. Does your product meet requirements of the following specifications? Please write the specification number, classification and type or subgroup when appropriate (i.e. AASHTO M 148, Type I D, Class A)

AASHTO	<u>see attached</u>	<u>product data sheet</u>	_____	_____	_____
ASTM	<u>see attached</u>	<u>product data sheet</u>	_____	_____	_____
FEDERAL	<u>see attached</u>	<u>product data sheet</u>	_____	_____	_____
UDOT	<u>see attached</u>	<u>product data sheet</u>	_____	_____	_____

11. Is product approved for use by other highway authorities or agencies?

(Indicate by whom used and whether use is routine or experimental only) Tennessee DOT-routine, Maine DOT-routine.

Product is pending in the following DOT's- Georgia, Mississippi, Texas, Arkansas

12. Who recommended that the Department be contacted? Not sure

13. Has another office of UDOT been contacted? ☒ YES ☐ NO If YES, Whom? Region 4 Cedar District (did demo 6-17-03)

Please answer the following questions by placing an X in the appropriate box:

YES NO

- ☒ ☐ Can a demonstration be provided?
☒ ☐ Are ☐ videos or ☒ educational training courses available?
☒ ☐ Can ☒ plans, ☐ drawings, or ☒ pictures be furnished by manufacturer?
If Yes, ☒ Copy attached ☐ To be mailed.
☒ ☐ Are instructions or directions for installation, application or use available?
☐ ☒ Is availability seasonal?
☒ ☐ Can samples be provided ☒ free or ☐ at cost for laboratory/field testing?

Approximate cost for samples? \$ _____

Signature


(Needed for follow up correspondence.)

• • Please attach trade literature, test results, testimonials, specifications,
MSDS sheets, instructions, warranty, samples, etc. • •

Please submit this form to:

UDOT -- Research Division
Attn: Barry Sharp
4501 South 2700 West - Box 148410
Salt Lake City, UT 84114-8410

or fax to : (801) 965-4796

For your questions or comments our engineering staff is available M-F from 7am to 5pm (MST),

Dan Avila, P.E.
Development & Implementation
Program Manager
(801) 965-3890

Robert Stewart
Development Engineer
(801) 965-4333

R. Barry Sharp
Research Specialist
(801) 965-4314

E:\Work\Web Design\Product Listings\Dec 00 API\452.htm

APPENDIX E: PRODUCT DATA SHEET



420 N. Roosevelt Ave. • Chandler AZ 85226
1-800-528-8242 • (602) 276-0406 • FAX (480) 961-0513
www.crafco.com

PRODUCT DATA SHEET

TECHCRETE TYPE R

PART NO. 34957(Cold), 34952(Standard), 34951(Hot)

JULY 2002

READ BEFORE USING THIS PRODUCT

GENERAL TechCrete (Type R) is a hot applied polymer modified resin based flexible concrete repair material. Used to repair cracks, spalls, pop-outs, failed joints and most types of defects in concrete surfaces up to a maximum depth of 3/4 inch (20 mm). TechCrete is gray in color, similar to the surfaces in which it is to be applied, therefore it is aesthetically suitable in all concrete pavements. The unique design features of TechCrete produce an impervious, impact resistant, load bearing, highly flexible repair that withstands vehicle traffic, aircraft movements and climatical conditions once installed. TechCrete is supplied in powder form in melt pack bags. The material is carefully placed, complete with bag, in the TechCrete Melter Mixers, melted and heated to the correct working temperature. The melted material is then poured into the prepared pavement section and leveled. The repair is left to cool and solidify prior to opening to traffic. (See Application Instructions).

PROPERTIES

Properties of TechCrete Type R are as follows:

Parameter	Cold	Standard	Hot
Temperature ranges	68°F (20°C) to -13°F (-24°C)	80°F (28°C) to 24°F (-5°C)	140°F (60°C) to 40°F (5°C)
Color	Gray	Gray	Gray
Form	Powder	Powder	Powder
Specific Gravity	1.7	2	2
Softening Point,ASTMD36	185°F (85°C) (min.)	212°F (100°C) (min.)	239°F(115°C) (min.)
Flow Test (5 hrs@140°F(60°C) ASTMD3407/BS2499	3 mm (max.)	3 mm (max.)	3 mm (max.)
Slump Test (cone) 3 hrs @ 158°F(70°C)	5% (max.)BS3262 Part I	5% (max.)BS3262 Part I	5% (max.)BS3262 Part I
Penetration Test@ 77°F(25°C)	7.5 mm (max.)	-	-
Extension Test @19°F(-7°C)extension	100% ASTMD3405	-	-
Extension Test 1 mm/min. @ 77°F(25°C)	-	ASTMD5329	ASTMD5329
Newton Force Extension	3500 Newton load	750 N (max.) 80% (min.)	650 N (max.) 25% (min.)
Compression Resistance 10 mm/min. @ 73°F(23°C)	(min.) @ 50% compression	3500 Newton load (min.) @ 50% compression	3500 Newton load (min.) @ 50% compression
Wheel Tracking @ 122°F(50°C) mm/hr	20 mm specimen 3mm/hr (max.)BS598-110:98	20 mm specimen 3mm/hr (max.)BS598-110:98	20 mm specimen 3mm/hr (max.)BS598-110:98
Max rut depth	5 mm (max.)	5 mm (max.)	5 mm (max.)
Binder Extension Test, 2.5 mm/min.@ 72°F(22°C), Newton force	350 N (max) ASTM D5329	-	-
Extension	700%	-	-
Binder Extension Test, 1 mm/min.(5 cycles) @72°F(22°C) Newton force	-	Single extension 400 N (max.)ASTM D5329	550 N (max.)ASTM D5329
Extension	-	300% (min.)	50% (min.)
Artificial Weathering	1000 hrs (min.)BS3900/part F3	1000 hrs (min.)BS3900/part F3	1000 hrs (min.)BS3900/part F3
De-icer Fluid	Resistant	Resistant	Resistant
Min. Application Temp.	375°F (190°C)	375°F (190°C)	375°F (190°C)
Max. Application Temp.	428°F (220°C)	428°F (220°C)	428°F (220°C)
Shelf Life	2 years	2 years	2 years

APPLICATION Prior to use, the user must ensure that the Material Safety Data Sheet and Application Instructions are read and followed.

PACKAGING The materials are packed in Melt Pack Bags of approximately 55 pound (25 kg) ± 2 pounds (1 kg). The bags are packed on pallets. Each pallet hold approximately 39 bags (2,145 ± 80 pounds). Pallets of TechCrete are weighed and the product is sold by its net weight.

WARRANTY Crafco, Inc. warrants that Crafco sealants meet applicable ASTM, AASHTO, Federal or State specifications at time of shipment. Techniques used for the preparation of the cracks and joints prior to sealing are beyond our control as are the use and application of the sealants; therefore, Crafco shall not be responsible for improperly applied or misused sealants. Remedies against Crafco, Inc., as agreed to by Crafco, are limited to replacing nonconforming product or refund (full or partial) of purchase price from Crafco, Inc. All claims for breach of this warranty must be made within three (3) months of the date of use or twelve (12) months from the date of delivery by Crafco, Inc. whichever is earlier. There shall be no other warranties expressed or implied. For optimum performance, follow Crafco recommendations for sealant installation.

APPENDIX F: COST AND QUANTITY INFO

Cost data for TechCrete

Cost per cubic foot

For budget purposes - the design is 10' long by 12" wide by 2" deep = 1.6cf

Operation	Labor / equipment	Hours	Total	\$/cf
1hr pre heat	Labor / truck	1.00	68.75	42.97
This is a fixed cost that will change with quantity.				
Layout	Forman / truck	0.15	12.19	7.62
Saw and chip area	2 labor / saw/compressor truck	0.50	103.13	64.45
Clean	Vacuum truck / labor	0.15	29.06	18.16
Heat	Labor / propane	0.15	11.25	7.03
Place material	3 labor / truck / kettle	0.25	62.50	39.06
Purchase material	1.6cf	1.60	346.66	216.66
			633.53	395.96

APPENDIX G: PRODUCT INFORMATION SHEET

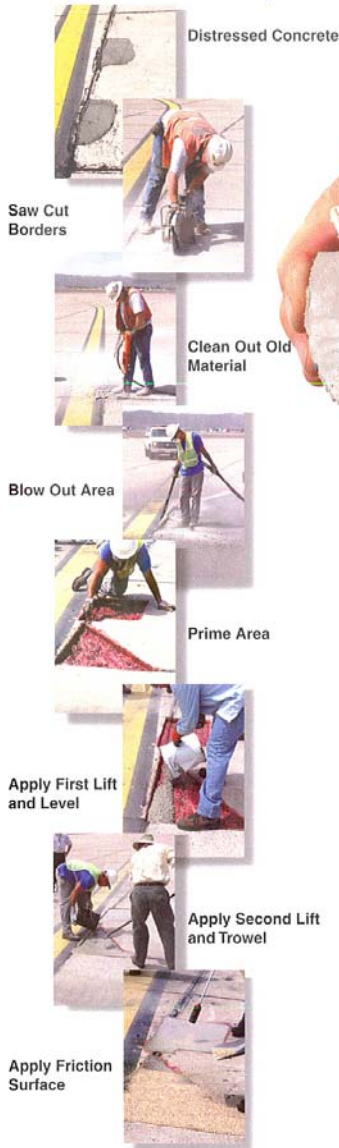
Old
Problems
Solved
with
New
Repair
Techniques

CRAFCO™
AN ERGON COMPANY

TECHCRETE™
the flexible solution to concrete repair

PEOPLE • PRODUCTS • KNOWLEDGE

the superior solution for concrete repair



Easy Application!

Preparation:

The defective concrete is removed by conventional methods (saw cut and broken out by pneumatic means or milling). The area is cleaned out using hot compressed air and is verified that the area to be treated is clean and dry.

Installation:

After the area has been prepped it is primed to enhance the material bond to the pavement. The hot applied self-leveling TechCrete is then poured into the cavity and floated to an even surface. The surface is then coated with the friction material.

Crafco **TechCrete** is the long-term solution for distressed concrete pavement preservation. Spalled concrete caused by fatigue, freeze/thaw cycles, warping stress, ingress of water, or substrate problems can lead to costly reconstruction. Crafco **TechCrete** is a proven hot pour superior repair solution different from conventional rigid repair methods. Due to its flexibility, high tensile strength, ability to bridge joints and high compressive resistance, **TechCrete** creates a long lasting concrete repair. Conventional rigid cement repairs such as epoxy or fast curing cementitious products often fail due to de-bonding, fatigue, and differential expansion characteristics, all resulting in additional cracking and the need for repeated repairs. These methods of repair have not only proven to be expensive but also short term. Once in place Crafco **TechCrete** will move with the pavement and will not de-bond or crack. **TechCrete** repair system has excellent adhesion and has a high friction surface ideally suited for Thin Bond Repair (TBR), multi corner slab repair, joint intersection repairs and recessed applications. Repairs with Crafco **TechCrete** can be opened up to traffic within as little as one hour. **TechCrete** is the most advanced concrete fix available and is ideal for highway and airport pavement repair. With Crafco **TechCrete** it's a one-time fix.



- Long Lasting Concrete Repair
- Excellent Adhesion
- Flexible
- Compressive Resistant
- High Tensile Strength
- Spans Joints
- Ideal for Recessed Areas
- Ideal for Multi Corner Slab Repairs
- Open to Traffic in About One Hour

WWW.CRAFCO.COM

For more information on Crafco products contact your local Crafco Distributor or call:

800-528-8242

420 N. Roosevelt Ave.
Chandler, Arizona 85226
Phone 602-276-0406
Fax: 480-961-0513

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APPENDIX H: FEEDBACK FROM REGION PERSONNEL

The following comments have been reformatted from their original version to correct formatting issues. The comments were received on 12 August, 2008, in response to a request issued by UDOT's Research Division. The comments were attached to a .pdf file printed from this report, prior to the addition of this appendix, and the corresponding section 5.1.

- "Cost high for repairs on a shed level."
- "Larger capacity machine needed for to speed installation of materials; too much time heating materials."
- "Sand that was used in final process appears to have worn off and left bald spots."
- "Spalling of concrete through out test section."
- "Self leveling applies on flat surfaces any structure with super requires more effort to move materials in place."
- "If heated too much material will catch on fire! On last step in applying sand."

APPENDIX I: WATERPROOFING MEMBRANE STANDARD SPECIFICATION

SECTION 07105

WATERPROOFING MEMBRANE

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Prepare an entire concrete deck and the approach slabs or specified structure joint areas for waterproofing membrane.
- B. Place waterproofing membrane.

1.2 RELATED SECTIONS

- A. Section 03934: Structural Pothole Patching

1.3 REFERENCES

- A. ASTM C 578: Rigid, Cellular Polystyrene Thermal Insulation
- B. ASTM D 5: Penetration of Bituminous Materials
- C. ASTM D 36: Softening Point of Bitumen (Ring-and-Ball Apparatus)
- D. ASTM D 146: Sampling and Testing Bitumen-Saturated Felts and Woven Fabrics for Roofing and Waterproofing
- E. ASTM D 882: Tensile Properties of Thin Plastic Sheeting
- F. ASTM D 3236: Apparent Viscosity of Hot Melt Adhesives and Coating Materials
- G. ASTM E 96: Water Vapor Transmission of Materials
- H. ASTM E 154: Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS

- A. Manufacturer's product data, specifications, and recommended installation instructions.

1.6 WEATHER LIMITATIONS

- A. Do not work during wet conditions or when the deck or ambient air temperatures are below 50 degrees F.
- B. Do not apply the membrane unless the deck is surface dry.

1.7 SCHEDULE

- A. Notify the Engineer at least one week before installing the membrane.

PART 2 PRODUCTS

2.1 HOT POURED POLYMER MEMBRANE

- A. Characteristics:
 - 1. Single Component Elastomeric Material
 - 2. Applied hot
 - 3. Spreadable to uniform thickness after cooling
 - 4. ASTM C 578
- B. Mechanical Properties:
 - 1. Penetration, Max: 100
 - 2. Pliability, at 10 degrees F: No cracks when bent 180 degrees over a 1-inch mandrel.

2.2 RUBBERIZED ASPHALT MEMBRANE

- A. Characteristics:
 - 1. Laminate Form
 - 2. Heat Resistant
 - 3. Self-adhesive surface protected by special release paper

B. Mechanical Properties:

Table 1

Mechanical Properties		
Property	Method	Value
Thickness, inch min.		0.065
Permeance-Perms, grains/sq ft·hr·inhg	ASTM E 96, Method B	0.10
Tensile Strength, psi	ASTM D 882, modified for 1 inch opening	50
Elongation, percent	ASTM D 882, modified for 1 inch opening	75
Puncture Resistance (Mesh), lb	ASTM E 154	200
Pliability, at -15 degrees F	ASTM D 146	No cracks in mesh or rubberized asphalt when bent 180 degrees over a ¼ inch mandrel

2.3 PATCHING CONCRETE

- A. Refer to Section 03934.

2.4 FIBERGLASS MATTING

- A. Weight = 1.5 lb/yd²

2.5 BINDER

- A. Compatible with the matting material and conforming to the following requirements:

Table 2

Binder Requirements		
Property	Method	Value
Penetration, 0.1 mm	ASTM D 5	40-82
Softening point, min.	ASTM D 36	155 degrees F
380 degrees F. viscosity, cps	ASTM D 3236	1,000 - 1,800

PART 3 EXECUTION

3.1 PREPARATION

- A. Concrete deck:
 - 1. Sandblast to remove asphalt and all other foreign material from the entire deck, approach slabs, and sides of the parapet for a height of 4 inches above the concrete deck.
 - 2. Vacuum or use compressed air to remove all dust and loose material from the deck.
 - 3. Remove all sharp ridges and projections that can puncture the membrane.
 - 4. Patch holes or spalled areas in the concrete deck with patching concrete to provide a flat deck surface. Refer to Section 03934.
- B. Asphalt Surface: Apply a ½ inch layer of Hot Mix Asphalt as shown on the plans to provide a flat deck surface when membrane will be placed on an asphalt surface.
- C. Joints and Cracks: Bond a 12 inch wide strip of woven fiberglass reinforcing to the deck over cracks and joints greater than $\frac{3}{16}$ inch wide using a compatible binder.

3.2 APPLY MEMBRANE

- A. Use either hot poured polymer membrane or rubberized asphalt membrane.
- B. Hot pour polymer membrane: Follow manufacturer's recommendations for application temperatures, equipment, and procedures.
 - 1. Primer: Apply primer according to the instructions of the membrane manufacturer, if required.
 - 2. Application Rate: Apply at a uniform rate to yield a minimum membrane thickness of $\frac{3}{32}$ inch.
 - 3. Vertical Surfaces: Apply the membrane on existing vertical surfaces and curb faces to a height 1 inch above that required for the asphalt surfacing overlay without splattering.
 - 4. Defects: Repair membrane that exhibits pin holes surface blisters, crazing, or cracking after cooling.
 - 5. Protection: Protect the membrane from damage by using asphalt roofing felt (30 lb/200 ft²) when asphalt surfacing is not placed within four hours of placing waterproofing membrane. Observe the following characteristics and procedures when using the asphalt roofing felt:
 - a. Cover entire surface and lay dust side up.
 - b. Lay parallel to the centerline of the roadway with a minimum overlap of 4 inches between adjoining sections.

- c. Bond overlap with suitable mastic or cement.
 - d. Place free of wrinkles, bubbles or other defects. Repair any placement defects.
 - 6. Traffic: Allow only necessary rubber tire vehicles on the membrane system.
 - a. Do not allow public traffic.
 - b. Maintain the roofing material in good condition until covered with pavement.
 - 7. Preparation for overlaying: Do not use a tack or prime coat on the top surface of the asphalt rolled roofing.
- C. Rubberized Asphalt Membrane: Follow membrane manufacturer's recommendations for application temperatures, equipment, and procedures.
- 1. Primer: Use primer furnished by the manufacturer of membrane material. Apply primer to all surfaces to be covered by the membrane according to the manufacturer's recommended procedure and application rate.
 - 2. Placement: Overlap prefabricated membrane strips at least 4 inches. Place joints in a shingling effect so water will drain effectively.
 - 3. Bonding: Use hand rollers or other satisfactory pressure apparatus on the membrane to assure firm and uniform contact with the primed surfaces. Use a wide tipped torch to cause tackiness if an adhesive is required to create a good seal at joints.
 - 4. Placement: Place the membrane on the vertical face of the concrete curb to the height of the finished overlay surfacing.
 - 5. Defects: Protect the entire membrane from developing wrinkles, air bubbles, or other placement defects. Patch any torn or cut areas and narrow overlaps using a satisfactory adhesive and a piece of membrane. Extend the patch at least 4 inches beyond any defect. Bond the patch firmly to the surface.
 - 6. Traffic: Allow only necessary rubber tire vehicles on the membrane. Do not allow public traffic. Maintain the membrane in good condition until covered with pavement.
 - 7. Preparation for Overlaying: Apply a bond coat of an acceptable adhesive to the surface of the membrane if required by the membrane manufacturer.

3.3 ASPHALT SURFACING OVERLAY

- A. Place required surfacing after the membrane has cured according to manufacturer's recommendations. Deposit, spread, and roll asphalt material so the membrane will not be damaged.

END OF SECTION